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Myocardial Ischemia

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Myocardial ischemia

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Myocardial ischemia occurs when there is not sufficient myocardial oxygen supply to meet the body's demand for it. Oxygen demand is dependent upon heart rate, myocardial contractibility, afterload, and preload. Atherosclerotic coronary artery disease is the most common cause of myocardial ischemia; other etiologies include coronary artery vasospasm, embolism, dissection, and arteritis.

The normal coronary arteries have reserve capacity for increased oxygen demand during periods of physical activity. Patients with coronary artery disease are unable to keep up with the increased demand of activity. When disease advances enough that the coronary arteries become unable to keep up with the increased demand for oxygen, ischemia occurs, causing angina. *Angina* is a difficult to describe tightness, burning, or sensation of a heavy weight sitting on the chest. It usually causes a sense of discomfort rather than pain in the chest, neck, lower jaw, and down the arm. Sharp and stabbing pain is not typical of angina. Associated symptoms of shortness of breath, nausea, indigestion, and diaphoresis are common. Symptoms generally last 2-5 minutes.

Initial treatment of ischemia includes stopping the activity that caused the pain and administering sublingual nitroglycerin. Nitroglycerin will relieve pain caused by esophageal spasm or other GI problems, as it relaxes smooth muscle.

Besides a history of chest discomfort, the ECG is used to establish a diagnosis of myocardial ischemia. Abnormalities in the ST segment represent myocardial ischemia. After prolonged ischemia, infarction results, which will be discussed in next month's column. Clinicians should bear in mind that the ECG may sometimes be normal or nonspecific in a patient with either ischemia.

Under normal conditions, the ST segment is relatively isoelectric. Ischemia (angina) will initially cause ST segment depression. If ischemia continues to the point of infarction, the ST segment will become elevated. Other causes of ST depression include left ventricular hypertrophy.

ECG CHALLENGE

A 73-year-old male presents to your office complaining of chest pressure when he walks his dog. If he stops to rest or sits down, the pain subsides. He has no radiation of pain and no other symptoms. The patient has used nitroglycerin twice and has come in to see you upon urging from his wife. An initial ECG was obtained (**Figure 1**).

Let us look at this ECG.

1) Is the **rhythm** regular? Yes.

2) Let's look at the **rate**. A) Count the big boxes between QRS complexes: 300, 150, 100, 75, 60. There are a little more than 6. Six would be 60; since it is a little less, you can estimate 55. B) Count the number of QRS segments in 6 seconds (30 boxes) and multiply by 10. 6 x 10 = 60. C) Count the number of large boxes between the QRS and then divide 300 by the number of large boxes. 300 divided by 5 = 60.

3) **P waves** are present, so it is a sinus rhythm.

4) The **PR interval** is normal.

5) The **QRS complex** measures less than 3 small boxes. This is a normal QRS complex.

6) The **ST segment** is neutral; therefore, no ischemia is present.

7) The **T wave** is positively deflected in all leads except for aVR.

8) **No U waves** are present.

This patient had sinus bradycardia. Otherwise, this ECG is normal. Since the patient had typical stable angina, a stress test was ordered. The patient arrived for the stress test feeling great. The initial ECG before the stress test continued to show sinus bradycardia. During the stress test, the patients developed chest pressure; a second ECG was obtained (**Figure 2**).

1) Is the **rhythm** regular? Yes.

2) What is the **rate**? A) Count the big boxes between QRS complexes: 300, 150, 100, a little before 100. You can estimate the rate to be 110. B) Count the number of QRS in 6 seconds (30 boxes) and multiply by 10. 11 x 10 = 110. C) Count the number of large boxes between QRS segments and then divide 300 by the number of large boxes. 300 divided by 3 = 100.

3) Now look for **P waves**. Although hard to see, they are there. This is a sinus rhythm.

4) **PR interval** is normal.

5) **QRS complex** is less than 3 small boxes.

6) Is the **ST segment** neutral, elevated, or depressed? It is depressed 2-2.5 mm in leads II, III, aVF, and 1-2 mm in V3 to V6. This is an ischemic response to exercise.

7) **T waves** are normal.

8) There is **no U wave**.

This patient had a positive stress test and was scheduled for a cardiac catheterization. **JAAPA**

Figure 1

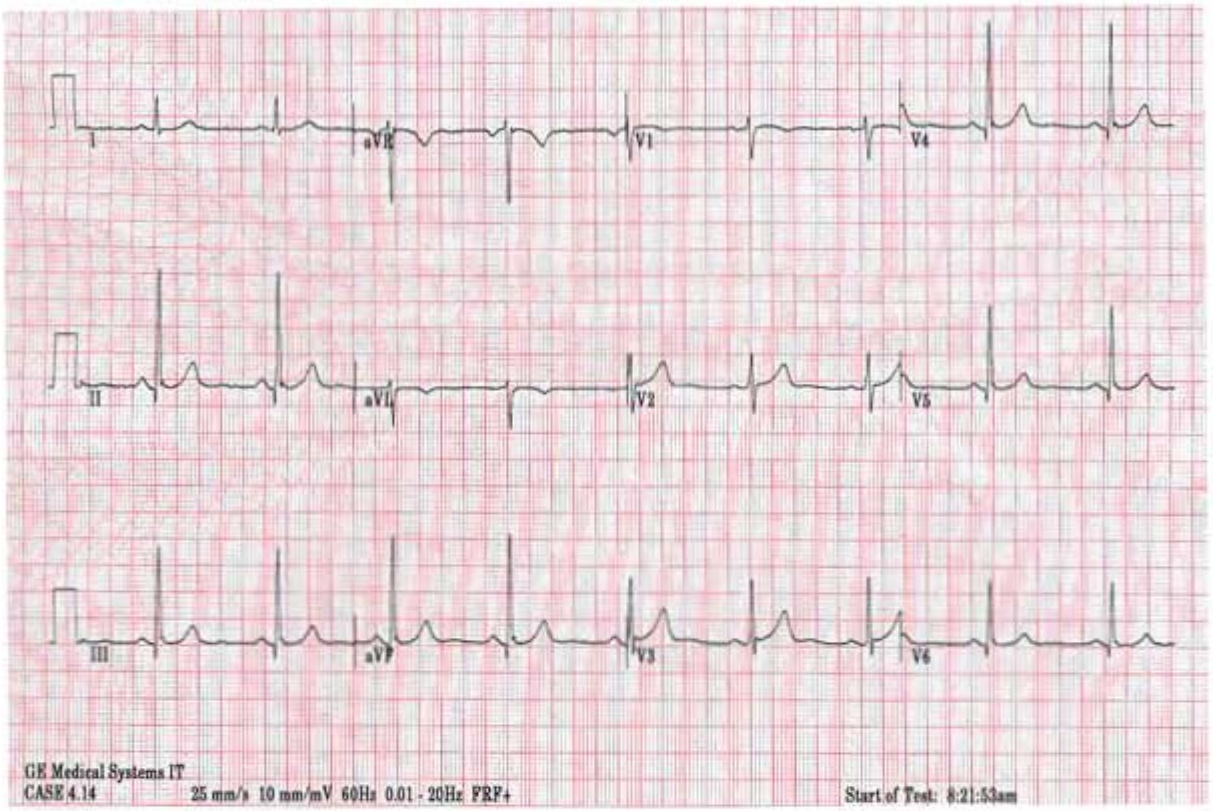

Figure 2